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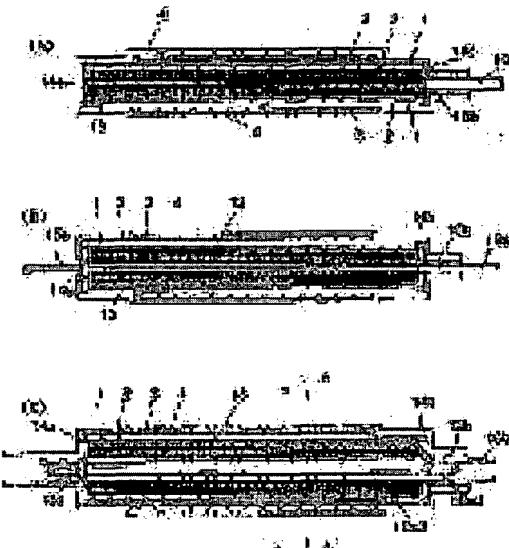
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## (54) FUSED CARBONATE FUEL CELL AND ELECTRIC POWER GENERATING DEVICE USING THE SAME

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a fused carbonate fuel cell with reduced cost by making a costly component of a separator limited only to a cathode current collecting plate.

**SOLUTION:** For the fused carbonate fuel cell, anode electrodes 2 contacting with the both surfaces of a foamed metallic body 13 with appropriate compression strength and gas permeability are arranged, and electrolyte plates 1 are arranged so as to contact the outer surface of the anode electrodes respectively, and cathode electrodes 3 in smaller area than that of the electrolyte plate are arranged so as to contact the outer surface of the electrolyte plates respectively, and a flat and square tube is formed by covering the outer surface of the above by a cathode current collecting plate made of metal plate, and plenty of penetrating small holes and a convex part for housing the cathode, facing outside with almost the same shape as the cathode, into which the cathode is housed, are formed at the part where the cathode current collecting plate contacts the cathode electrode.



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**CLAIMS**

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**[Claim(s)]**

**[Claim 1]** In contact with both sides of a foam-metal object which have proper compressive strength and proper permeability, an anode electrode is arranged, respectively by plate-like. Arrange an electrolyte plate so that each of the external surface may be touched, and a cathode electrode with an area smaller than an electrolyte plate is arranged so that each of the outside may be touched further. It covers with the cathode collecting electrode plate which is a metal plate as the outside of the whole is touched. At the same time it prepares the stoma of a large number to penetrate in the portion which is made to form a flat square shape tube and touches the cathode electrode of the cathode collecting electrode plate by it. The heights to the outside of the almost same configuration as the cathode for containing a cathode are formed. Arrange so that the above-mentioned cathode electrode may be contained by the inside, and the flat-surface section prepared in the periphery of a cathode collecting electrode plate contacts the external surface of an electrolyte plate, and directly, and forms a wet seal. The fused carbonate fuel cell characterized by making the fuel cell of the couple in a parallel state form in the outside of the sink of fuel gas, such as hydrogen, and a cathode collecting electrode plate by passing the oxidizer gas containing oxygen and a carbon dioxide at the portion of a foam-metal object.

**[Claim 2]** The fuel cell which arranges the interchange connector which has electronic conductivity so that a cathode collecting electrode plate may maintain an insulation although opening of the side of one side of the cathode collecting electrode plate of the fuel cell shown in a claim 1 is carried out and a foam-metal object touches, and shows using two or more same type fuel cells, the foam-metal object of the interchange connector being connecting the edge of an opposite side with the

cathode collecting electrode plate of the adjoining same type fuel cell, and connecting in series to the claim 1 by which it is characterized.

[Claim 3] The fuel cell which is dividing, arranging the interchange connector which has conductivity by the shape of sheet metal in the meantime, making the end extend to the outside of a cathode collecting electrode plate after the cathode collecting electrode plate has maintained the insulation for it, and connecting the portion with the cathode collecting electrode plate of the adjoining same type fuel cell level 2 in the center section of the foam-metal object of the fuel cell shown in a claim 1, and shows using two or more same type fuel cells, connecting in series to the claim 1 by which it is characterized.

[Claim 4] The fuel cell which shows constituting so that it may have a spring function, always binding tight into the portion of a fuel cell between a cathode collecting electrode plate and an interchange connector, and having made it the force work with the matter which has conductivity for the portion of a sheet metal-like interchange connector shown in a claim 3 to the claim 1 by which it is characterized.

[Claim 5] In one housing, sequentially from a top, a steam generator, a steam superheater, a reforming machine, Arrange perpendicularly the burner for starting, a fuel cell, and a catalyzed-combustion machine, and, on the other hand, housing is made into double-frame construction. When air passes along the meantime, it is made for the internal surface of a double wall to turn into the heating surface as an air preheater. The equipment which supplies fuel gas to the burner for starting, lights it from the exterior, preheats the equipment located upwards from the burner for starting by the combustion gas of the burner for starting, and is located below the burner for starting By becoming hot beforehand with the air which was introduced from the lower part of housing based on the free convection and which it preheated It enables it to preheat the whole equipment, without worrying about damage on the fuel cell by generating of a drain to during starting. subsequently It is supplying superheated steam and hydrocarbon gas to a reforming machine, the reformed gas passing a fuel cell as it is, burning with a catalyzed-combustion vessel, carrying out the temperature up of a catalyzed-combustion machine and the fuel cell to an operating temperature by it, and paying a fuel cell subsequently to power generation. The power plant which used the fuel cell which shows having enabled it to start, without [ without it uses the utility from the outside, and ] worrying about a drain trouble to during starting to the claim 1 by which it is characterized.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001] A [Field of the Invention] this invention belongs to the field of energy-conversion equipment, and relates to the power plant using a fused carbonate fuel cell and this in the fuel cell which transforms into the direct electrical and electric equipment the chemical energy which fuel has.

[0002] [Prior-art] drawing 6 (A) is structure currently most generally as structure of a fused carbonate fuel cell used. Although it was the easy structure where the anode electrode 2 made from the sintering object of a metal powder, respectively and the cathode electrode 3 were stuck and every method was fundamentally the same as the both sides of the electrolyte plate 1 which fabricates the powder of a ceramic to plate-like and held the carbonate which is an electrolyte to the space between the particle, the metal structure called separator with the conventional technology was very complicated structure, and the cost of one fuel cell was also high. To the anode corrugated board 5 for forming the path which passes fuel gas, such as hydrogen, to an anode, and a cathode, namely, oxygen, The pin center,large plate 6 as a diaphragm it is made for the cathode corrugated board 7, and the fuel gas and oxidizer gas for forming the path which passes the oxidizer gas containing a carbon dioxide not to mix, and an anode electrode are supported. And five basic components of the cathode collecting electrode plate 4 for supporting the anode collecting electrode plate 8 for making electrical installation of the polar zone good and a cathode electrode, and making electrical installation of the polar zone good are required. In addition, the mask plate 9 for fuel gas and each oxidizer gas not leaking out outside is needed for each corner, and there are very many part mark, they are complicated, a weight's are heavy,

and cause a cost rise.

[0003] Drawing 6 (B) is new invention for improving the above-mentioned fault, and is shown in Japanese Patent Application No. 08-67656. This method makes the anode collecting electrode plate 8 the structure of the shape of a flat square shape tube. Arrange the anode electrode 2 on both the external surface, respectively, and an electrolyte plate 1 is arranged on both the external surface, respectively. Furthermore, arrange the cathode electrode 3 on both the external surface, and these whole is covered with the cathode collecting electrode plate 4. It enables it to generate two fuel cells in a parallel state simultaneously by forming two fuel cells which are in a parallel state in one unit, passing fuel gas to a part for the centrum of the center, and passing oxidizer gas on the outside of the cathode collecting electrode plate 4. Separator becomes only two components, the anode collecting electrode plate 8 and the cathode collecting electrode plate 4, three components, the pin center, large plate 6, the anode corrugated board 5, and the cathode corrugated board 7, become unnecessary, and this structure simplifies structure remarkably, and reduces cost. Since it is related with the further improvement of this drawing 6 (B), this invention is hereafter described mainly in comparison with drawing 6 (B).

[0004] [Problem(s) to be Solved by the Invention]

(1) If compared with drawing 6 (A), although drawing 6 (B) will lower part mark remarkably and cost will be reduced, it is the anode collecting electrode plate 8 which has the highest cost in it. In order that it may contact the carbonate (one of the mixed salts of Li<sub>2</sub>CO<sub>3</sub>-K<sub>2</sub>CO<sub>3</sub> or Li<sub>2</sub>CO<sub>3</sub>-Na<sub>2</sub>CO<sub>3</sub> are usually used) which is in a melting state in reducing atmosphere, since nickel is used from a corrosion resistance viewpoint, it is very expensive, and if the anode collecting electrode plate 8 has a method of excluding this, it is very effective in a cost cut.

(2) Another is related with the root on which the electrical and electric equipment flows, and its electric resistance. An electron is absorbed by the reaction of CO<sub>2</sub>+1/2O<sub>2</sub>+2 e=CO<sub>3</sub><sup>2-</sup> by the cathode electrode, a carbonate ion is generated, as for a fused carbonate fuel cell, this carbonate ion moves the inside of an electrolyte plate to an anode, and an electron is emitted by the reaction of H<sub>2</sub>+CO<sub>3</sub><sup>2-</sup>=H<sub>2</sub>O+CO<sub>2</sub>+2e by the anode electrode. Therefore, electron flow will be formed if a cathode is connected with an anode in an external circuit. However, the electromotive force of one fuel cell is as low as about 0.7-0.8V practical, usually, from several 10, it connects in series and the fuel cell of a 100 number is used. Since, as for the electron transfer from an anode to the following cathode, the whole surface of a fuel cell serves as a path through metaled separator by the fuel cell of a conventional type

shown in drawing 6 (A) at this time, most electric resistance in the meantime is so small that it may be disregarded. However, in the case of drawing 6 (B), the electron brought together in the anode collecting electrode plate 8 flows the thin anode collecting electrode plate 8 horizontally, in order to go to the following cathode collecting electrode plate 4, and since it is carried by the cathode collecting electrode plate 4 through an interchange connector, it has the inclination for the electric resistance in this portion to become large. However, the method of drawing 6 (B) can take out independently the fuel cell unit of the couple in two parallel states compared with the method of drawing 6 (A), has the feature that cost is cheap, the top in which an electrolytic supplement and an electrolytic maintenance are possible, and, as for these, is [ more than the above-mentioned fault ] valuable. Therefore, it will be very worthy if the electric resistance between fuel cells can be reduced after employing this feature efficiently. Of course, it is made of the metal, and electronic conductivity does not serve as an obstacle with eye a good hatchet and this electric resistance fatal in order to form a fuel cell extremely, since a generating efficiency is raised, I hear that the anode collecting electrode plate 8 has a desirable direction with little electric resistance, and it has it.

[0005] (3) It was impossible to be in the state where it stuck strongly between each fuel cell once constructing as a stack, since it uses carrying out the direct laminating of many fuel cells in the fuel cell of the conventional type furthermore shown in drawing 6 (A), and unifying as a stack, and to have taken it out, even when the performance of one fuel cell a metaphor and in it is bad, an electrolyte was not able to be filled up and a fuel cell was not able to be maintained. However, since drawing 6 (B) can tear each fuel cell apart, its supplement of an electrolyte is also possible also for maintenance of a fuel cell. On the other hand, when each fuel cell was torn apart, it was worried about the injury concerning the portion of a fuel cell bind tight, and the force is opened wide and according to deformation of a fuel cell portion. In drawing 6 (B), when considering the compression creep deformation in a long time although opening of the bolting force was prevented only using the geometrical spring effect of the cathode collecting electrode plate 4 as indicated by Japanese Patent Application No. 08-67656 as this cure, there is a fear of the ability not to necessarily say that it is enough only now. this invention aims at solving the trouble shown above. Namely, cost is sharply reduced because the purpose of this invention excludes the expensive anode collecting electrode plate made from nickel. A generating efficiency is raised by reducing the electric resistance between each fuel cell. It binds tight, even if it takes out an independent fuel cell unit, an electrolytic supplement and electrolytic

maintenance are enabled because the force is made not to be opened wide, and it is in offering the power plant which is compact and is flexible by the life of the cost reduction which leads these whole, and a fuel cell, and improvement in reliability.

[0006] [The means for solving a technical problem]

(1) The property required of the anode collecting electrode plate 8 Since electrons are collected from all the portions of the anode electrode 2, electronic-conduction nature's being good and the anode electrode 2 are what sintered nickel powder. In order to deform when the force is added from the exterior if it places directly on a corrugated board case [ like drawing 6 (A) ] since the intensity of itself is not not much high, a certain support is needed and the function to achieve this duty is also required. In this invention, it is improving so that a plate-like foam-metal object may be used instead of the anode collecting electrode plate 8 of drawing 6 (B). For example, the foam-metal object of about 90% of void contents has moderate compressive strength, and since the aperture is sufficiently small, it can use it as a base material of an anode electrode. Moreover, since 90% is space, it can be used also as a path of anode gas and the pressure loss is also small enough. Of course, since itself is a metal, electronic conductivity is good and it is satisfactory also to collection of the electron from an anode electrode.

(2) Considering the electric resistance when connecting many fuel cells in series, on the other hand For example, since the thickness which a metal actually occupies becomes the same, the foam-metal object whose void content is 90% by the anode car RENTO collector of a 0.5mm conventional type, and the thickness of 5mm Electric resistance in case the electrical and electric equipment flows crosswise [ of a board ] also becomes the same, and only now, since it is necessary to thicken thickness of a foam-metal object in order to lower electric resistance, it cannot be said that sufficient improvement was given. However, it uses that the foam metal itself has electronic conductivity, and by inserting a metal plate in the center section of the foam-metal object which is separated from an anode electrode, since the inside of the metal plate inserted through the foam-metal object also flows, the electrical and electric equipment can reduce electric resistance remarkably, at the same time it flows the inside of a foam-metal object. In this case, since it ends with easy processing at the same time it is not necessary to use expensive nickel aiming at anticorrosion, since this metal plate is separated from the anode electrode and it is not directly in contact with an electrolyte, cost is cheap and ends. Moreover, it can be used as an interchange connector by extending the end of this insertion metal plate to the outside, maintaining a cathode collecting electrode plate and an insulation.

[0007] (3) Moreover, in this invention, the following remedies are taken to opening of the bolting force concerning the fuel cell portion when tearing the unit of the fuel cell in the parallel state of a couple apart. That is, by giving the spring effect to the portion of the metal plate inserted in the center section of the foam-metal object, in order to improve electric resistance, it always binds tight between cathode collecting electrode plates, and the force was maintained. The corrugated plate which has the spring effect between them inserts, and it always binds tight to a fuel cell between a metal plate and a cathode car RENTO collector, and makes make into two sheets the metal plate inserted for the electric-resistance improvement as it was shown in drawing 11 (C) as one example, although various methods can specifically be considered, and be binding tight to the state made to transform some with a cathode collecting electrode plate, and the force work. It became a supplement of the electrolyte to a fuel cell, and maintainable, without the bolting force being wide opened by it, even if it separated the fuel cell independently. If the corrugated plate of one sheet and the plate of one sheet as shown in drawing 12 (E) are sufficient as an example of a metal plate with this spring effect and a pitch is fine -- the corrugated plate of one sheet -- it is good

(4) After being able to lessen part mark remarkable and being able to lower cost as above-mentioned, by the supplement of the electrolyte to a fuel cell, or having become maintainable Compared with the former, the life and reliability of a cell are markedly alike and improve. conventionally Since those who have technical knowledge advanced for the handling were required, since what has been used only for the use to which the object for the power industries etc. was restricted was made very simple, application became possible by this invention about it even at small general-purpose uses, such as home use. Therefore, the example was shown also about the simple and compact low-cost-die fuel cell power plant which applied the fuel cell of this invention effectively.

[0008] The desirable operation gestalt of this invention is explained with reference to a drawing below [the gestalt of implementation of invention]. In addition, the portion which is common in each drawing was considered so that as same the sign as possible might be used. Drawing 11 is the conceptual diagram showing the structure of the fused carbonate fuel cell in connection with this invention, and drawing 11 (A) shows the basic structure of this invention. The anode electrode 2 is arranged on both the superficies of the plate-like foam-metal object 13 having the permeability of proper compressive strength and gas, an electrolyte plate 1 is arranged on each of the superficies, the cathode electrode 3 with an area smaller than an electrolyte plate is

arranged on each superficies, and the whole is covered with the cathode collecting electrode plate 4 which consists of metal plates so that the superficies of the whole may be touched. A flat square shape tube is made to form by this. The heights to an outside to contain a cathode are made to form in the portion which touches the cathode electrode 3 of this cathode collecting electrode plate 4 in the almost same configuration as a cathode, and into it, it arranges so that the cathode electrode 3 may be contained to the inside. The electrolyte plate 1 which the inside of the cathode collecting electrode plate of a cathode electrode periphery has a flat-surface configuration, and becomes a coplanar fundamentally [ the inside of a cathode electrode ], and is in the inside contacts the portion which forms the flat surface of the cathode collecting electrode plate 4 of a cathode electrode periphery, and directly, a wet seal is formed in the portion, and with this seal, the fuel gas which flows the inside of the foam-metal object 13 flows out outside, bends, and is like. Moreover, the stoma of a large number to penetrate is prepared in the portion which touches the cathode electrode 3 of the cathode collecting electrode plate 4, and it becomes it with the path to the cathode of the oxidizer gas by which this flows the outside of the cathode collecting electrode plate 4. Moreover, opening is prepared in the side (drawing 11 (A) right-hand side) of one side of the cathode collecting electrode plate 4, a foam-metal object contacts directly, and it is in the state which maintained the insulation in the cathode collecting electrode plate 4, interchange connector 10a which has electronic conductivity is prepared, and it connects the other end to the cathode collecting electrode plate 4 of the same type fuel cell which extends and adjoins to the outside of the cathode collecting electrode plate 4. By carrying out by repeating this, two or more same type fuel cells can be used, connecting in series.

[0009] Insulating materials 14a and 14b are installed so that the both-sides side of the foam-metal object 13 may not contact the cathode collecting electrode plate 4 and directly. Moreover, the seal is carried out so that the fuel gas which sealant [ an insulation-cum- ] 15b is arranged between opening of the cathode collecting electrode plate 4 and interchange connector 10a, and maintains the insulation with the cathode collecting electrode plate 4 and interchange connector 10a, and flows the inside of the foam-metal object 13 may not leak outside. Of such composition, two fuel cells put on the parallel state are formed in both sides of the foam-metal object 13 as a couple. Drawing 11 (B) is the conceptual diagram showing the structure of the advanced fuel cell for reducing the electric resistance between each fuel cell in the case of using many fuel cells, connecting in series. It is the structure which divided and inserted metal plate 10b between them level 2 in the center section of the foam-metal object

of the fuel cell shown in drawing 11 (A). Although the electron collected with the foam-metal object 13 is transported to the cathode collecting electrode plate 4 of the adjoining same type fuel cell, in drawing 11 (A), the root will flow on the right from the left, if the inside of the anode electrode 2 and the foam-metal object 13 is said drawing, passes along interchange connector 10a, and moves it to the cathode collecting electrode plate 4 of the adjoining fuel cell. At this time, the portions of the anode electrode 2 and the foam-metal object 13 have the largest electric resistance. On the other hand, since the root which flows the inside of inserted metal plate 10b is added in the case of drawing 11 (B), the part electric resistance is reduced sharply. A breakthrough is suitably prepared in the portion which touches the foam-metal object 13 of this metal plate 10b, and inflow of gas and defluxion are enabled. Moreover, it extends besides the cathode collecting electrode plate 4, maintaining an insulating state only for the end in the cathode collecting electrode plate 4, and the portion is used as an interchange connector. In addition, in drawing 11 (B), in order to make an assembly easy, the fuel cell of a couple was manufactured independently, respectively and the method of manufacturing a pair in all of fuel cells for them afterwards is adopted. Therefore, gas-seal material 15a was added between two fuel cells. So that drawing 11 (C) is in a state as shown in drawing, the bolting force applied to a fuel cell when the fuel cell of a couple is taken out may be opened wide and a fuel cell may not be damaged by deformation In drawing 11 (B) which is the conceptual diagram showing the structure improved so that a bolting mechanism might be established into the fuel cell itself The portion of metal plate 10b inserted in order to reduce electric resistance is made into two sheets (drawing 11 (C) indicates as 10c1). The metaled corrugated plate 10c3 is inserted between them, the cathode collecting electrode plate 4 is bound tight until a corrugated plate 10c3 deforms moderately at the time of initial manufacture, and the reaction force of the corrugated plate 10c3 always binds tight into the portion of a fuel cell, and it is made to act on it as force. In addition, drawing 12 (D) is the conceptual diagram showing the A-A cross section of the metaled corrugated plate 10c3, and a wave is formed in the sense which intersects perpendicularly to the flow of fuel gas, and it is arranged so that it may not become the bypass path of fuel gas. Moreover, the seal ring 10c2 which has the spring effect in the place respectively near the right end section of the metal plate 10c1 of two sheets and the left end section of the cathode collecting electrode plate 4 of two sheets has been arranged, and leak to the exterior of fuel gas is prevented. Moreover, drawing 12 (E) is the conceptual diagram showing the improvement structure of the portions of 10c1 and 10c3 in drawing 11 (C), and changes the configuration of a

corrugated plate 10c3 except for one in the metal plate 10c1 of two sheets inserted for electric resistance reduction as follows. That is, it improves so that the excessive force may be applied to some foam-metal objects, and it may be made not to deform into it and the spring effect may be maintained by enlarging enough a touch area with the foam-metal object 13 of a corrugated plate 10c3, when a fuel cell is bound tight. [0010] I want to explain hereafter each part material which constitutes the above briefly, and to consider the structure demanded and a function as the supplement of explanation as to what thing it is. An electrolyte plate 1 fabricates the detailed particle of lithium aluminum NETO to sheet metal and plate-like, and makes the carbonate which is an electrolyte hold to the space of the particle. As a carbonate, one of the mixed salts of Li<sub>2</sub>CO<sub>3</sub>-K<sub>2</sub>CO<sub>3</sub> or Li<sub>2</sub>CO<sub>3</sub>-Na<sub>2</sub>CO<sub>3</sub> are used. Moreover, the anode electrode 2 and the cathode electrode 3 add some additives to the powder of nickel, and an electrode sinters it for them. Even if it uses these members by years of research for a long time, there is no big deformation by the compression creep. Moreover, what the foam-metal objects 13 are suitable selection of material and a suitable design specification, and has sufficiently high compressive strength, the permeability of gas, and electronic conductivity is obtained. As an example, even if the thing of 90% sky efficiency of Hastelloy X satisfies the above-mentioned demand and uses it for a long time; its deformation is also small. Therefore, what has so big the flatness capacity over bolting is not necessarily required. Although the corrugated plate of the metal inserted by the plate of two sheets was used as a mechanism in which the bolting force to a fuel cell is generated, in drawing 11 (C), even if it changes this spring mechanism from the above-mentioned background in the range which does not change the meaning of this invention, it is a change minute as invention and thinks that they are also contained in the range of this invention. Drawing 2 is the conceptual diagram showing the appearance structure of drawing 11 (C) in the fuel cell of this invention, and a fuel cell becomes the form contained in the container formed with the metal cathode collecting electrode plate 4. The lid 16 attached in upper flange 4a of the cathode collecting electrode plate 4 by the \*\* flange sticks, and the flange 18 for connection to the fuel gas supply pipe 17 and a fuel gas supply header is attached to the lid 16. Moreover, the cathode collecting electrode plate 4 of two sheets is bound tight with a bolt 20 in a bolthole four b1 and the portion of four b2 on both sides of a sealant 10c2, and forms one container. There is a perforated plate 19, insulating material 14c of porosity is on it, and the load of an electrolyte plate 1, the anode electrode 2, the cathode electrode 3, the foam-metal object 13, the inserted metal plate 10c1, and 10c3 grade is received in the pars basilaris ossis occipitalis in a

container there. The exhaust side of fuel gas is the same structure as fundamentally as a fuel gas supply side, and exhaust air consists of lid 16a of \*\*, exhaust pipe 17a, end-flange 18a with an exhaust air header, etc. Drawing 3 is the conceptual diagram showing the assembly structure of the compact fuel cell power plant which applies effectively the fuel cell of this invention shown in drawing 11, drawing 12, and drawing 2. Moreover, (B) shows the reforming machine and the related equipment, and (C) shows the cross section of a fuel cell for housing with which drawing 4 is the conceptual diagram showing some horizontal sections of drawing 3, and (A) consists of double walls.

[0011] Housing consists of wall 54a and outer wall 54b, and it has become the path of air between the double wall. The crowning of this air supply path is equipped with the lid 57 in which opening and closing and opening adjustment are possible. Moreover, the outside of outer wall 54b is covered with the heat insulator 56. As for during starting, fuel is supplied to the burner 40 for starting through the fuel-flow control valve 38 from the fuel gas storage container 37 with which it fills up with hydrocarbon system fuel gas under pressurization. The burner for starting has equipped with the ignition equipment by the piezoelectric device, and is lit by this. Since it is covered into the open state with the lid 57 which the inside of housing is filled with air, and is naturally in the crowning of an air supply path at this time, new air is supplied by the free convection in housing, and combustion gas is discharged from a housing crowning. It preheats the air supplied to housing by wall 54a, and it is introduced in housing through opening 54c prepared in the lower part of a wall. In this process, the equipment which exists above the burner 40 for starting, the reforming machine 31, a steam superheater 30, and steam generator 21 grade are directly heated by the combustion gas by the burner 40 for starting, and it preheats the reforming machine 31 to the temperature which can be reformed, and a steam generator 30 will be in the state in which steamy supply is possible. On the other hand, the heated air which is introduced from the lower part of housing preheats the equipment which exists below the burner for starting, the catalyzed-combustion machine 53, and fuel cell 42 grade. Mainly when reformed gas is introduced into a fuel cell, even the grade which a drain does not generate should just preheat the preheat temperature at this time. A reforming machine is started when it changes into this state. That is, superheated steam is first supplied to a mixer 34 through the superheated-steam supply pipe 32. Subsequently, a mixer 34 is supplied through the fuel gas flow control valve 39 from the fuel gas storage container 37. The material gas for reforming which is superheated steam and the mixed gas of fuel gas is supplied to the reforming machine 31 through a

line mixer 35 and material gas supply header 31a. If the reforming machine 31 is filled up with the reforming catalyst, the material gas for reforming passes through that and it is heated from the outside, material gas will be reformed at the gas containing hydrogen, a carbon monoxide, etc. This reformed gas is supplied to a fuel cell 42 through reformed gas header 31b, the reformed gas extraction 36, and the fuel gas supply header 41 for fuel cells. However, since the fuel cell has not resulted even in the temperature which can still be generated at this time, reformed gas passes the anode side of a fuel cell 42, and burns through the anode gas exhaust pipe 49 and the catalyzed-combustion dexterous fuel gas header 50 with the catalyzed-combustion vessel 52 which carries out the internal organs of the combustion catalyst 53. This combustion gas preheats a fuel cell 42 to the state which can be generated. Power generation will be started if the temperature which can generate a fuel cell 42 is reached. Electrically, a large number are connected in series and, as for a fuel cell 42, the electrical and electric equipment of an alternating current is taken out through the cables 47a and 47b for current ejection, and an inverter 48. If a power supply is prepared, it becomes possible to send the electrical and electric equipment to a control unit, a motor, etc., and an automatic controller is started the cathode blower 61 and if needed. Recycling of combustion gas is attained from a container crowning, and this enables it to reduce CO<sub>2</sub> utilization factor by the side of the cathode of a fuel cell 42. the mixing ratio of the combustion gas at this time, and new air -- a rate is adjusted with the dampers 59 and 60 in each line In addition, in drawing 4 (C), as a mechanism which binds a fuel cell tight from the outside, although the boards 44a and 44b for bolting, the spring 45, and the bolt 46 for bolting are indicated, it may be what indicated the concept of adding the clamping device from the outside if needed, and it may be an option to use a tension rod structurally etc.

[0012] Drawing 5 shows the process flow of the fuel cell small power plant shown in drawing 3 , and, if possible, the place which overlaps the explanation mentioned above using drawing 3 and drawing 4 is excluded. The water supply to a steam generator 21 fills up a raw water tank 63 with tap water, a river water, etc. first, supplies raw water to the demineralizer 65 which carries out the viscus of the ion exchange resin 66 through a bulb 64, and collects pure water in the pure water container 67. Subsequently, the pure water container 67 is raised to a position higher than a pure water storage tank 27, a bulb 68 is opened, and pure water is supplied to a pure water storage tank from a crowning. Although the bulb 69 for pure water supply and equalizing-valve 69a consider as close at this time, if a pure water storage tank 27 is filled with pure water, a lid will be shut and let equalizing-valve 69a be open.

subsequently, the float formula which makes open the bulb 69 for pure water supply, and is installed in a steam separation drum -- water level -- pure water is \*\*\*\*(ed) to the steam separation drum 22 through a control valve 70 A steam generator 21 is combustion gas of the burner 40 for starting the first stage, and is heated by the exhaust gas of a fuel cell 42 after that, and it generates saturated steam, circulating through a downcomer 23 and a generating tube 24 from the steam separation drum 22. The saturated steam line 25 is equipped with the equalization line of a pure water storage tank 27, the pressure gage 71, the own strength formula pressure regulating valve 72, and the rupture disc 73. On the other hand, the fuel gas storage container 37 has a removable flange or removable distributor shaft coupling 76, exchange is possible, and at the time of use, if a bulb 77 is opened, fuel gas will be supplied by the own strength formula pressure regulating valve 78 by the constant pressure. The fuel gas supply line to the reforming machine 31 and the burner 40 for starting is equipped with the fuel gas flow control valves 79 and 85 and flowmeters 80a and 86, respectively. The opening of this flow control valve is regulated by hand before a power generation start, a fuel gas flow rate and a steamy flow rate are set up, and after a power generation start is switched to automatic control if needed [, such as proportional control of a steam/fuel gas, ]. Moreover, in order to supervise the combustion temperature of the burner for starting, reforming temperature, and catalyzed-combustion machine combustion temperature, it has equipped with thermometers 81, 82, and 83, respectively. Power generation can be started by considering as such equipment and the starting method, without [ without it worries about the injury on the fuel cell by the drain to during starting and ] receiving supply of a utility from the exterior in any way.

[0013] The power plant using the fused carbonate fuel cell of this invention and this which carried out [effect-of-the-invention] \*\*\*\* has the following features.

- (1) Since it considered as the ultimate structure which cuts down the anode collecting electrode plate using an expensive material, and constitutes separator only from a cathode collecting electrode plate even if it compared the part mark of separator with invention of Japanese Patent Application No. 08-6765 cut down sharply compared with the fused carbonate fuel cell of the general former, a large cost cut is attained.
- (2) Since the electric resistance between each fuel cell when using many fuel cells, connecting in series was reducible, improvement in a generating efficiency is attained.
- (3) Since it considered as the structure where the bolting force concerning a fuel cell is maintainable when the fuel cell of the couple connected in parallel was independently taken out from a power plant, the electrolytic supplement and

electrolytic maintenance to each fuel cell become easy, and improvement in reliability, reinforcement, and the cost cut of them are attained.

(4) Incorporate the fuel cell which has the above-mentioned feature, and the fuel cell power plant which unified the whole power plant compactly does not have worries about damage on the fuel cell by the drain of during starting, and support of the utility from the outside is also unnecessary, and since it can generate electricity easily, the power plant of a low cost with high versatility, such as home use, is realizable.

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[Translation done.]